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An Informatics Solution for Operating Room Efficiency

Richard A. Barrow
University of San Francisco, barrow04@comcast.net

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Abstract

Problem: For most hospitals, a major cost is the operating room. Inefficiency increases costs and risks for adverse events. An efficient operating room can also be a major revenue generator.

Context: This evidence-based performance improvement project was conducted in a small rural Veteran's Hospital, which belongs to an integrated health network in Central California. The facility has four operating rooms and is expanding services provided to their patients.

Intervention: The intervention was the use of analytics and evaluations to improve the operating room efficiency by five percent. The use of 3 separate queries which were combined to generate reports and then some data were entered separately into IBM SPSS 24 for descriptive analytics. The reports provided measures to gauge operating room efficiency.

Measures: The analytic results were broken down into three reports. The first was titled Operating Room Times. The second was titled Operating Room Efficiency, and the third was titled Operating Room Utilization. The first was utilized to discern data errors and missing elements of data and to detect cancellations. The second to measure the difference between scheduled times and actual times. The third was for Operating Room utilization and overtime.

Results: Data errors decreased by 60% whereas cancellations, surgery start, and surgery end variance fluctuated. On-time starts did show some improvement by over 5%. Operating room utilization and overtime did not improve

Conclusion: The project did not achieve its objectives. There was not large buy-in for the project. There are other extenuating factors such as staffing shortages and no beds to admit patients to after surgery that further confounded the data. Data analytics alone cannot improve any area. There must be a desire from top-down for improvement. Plus, there must be a consensus and agreement on what needs to be improved.

Introduction

Problem

For most hospitals, a major cost is the operating room (OR). Inefficiency increases costs and risks for adverse events (Mull et al., 2014; Phieffer et al., 2016). An efficient operating room can also be a major revenue generator (Rempfer, 2015).

The efficiency of the OR is dependent upon many factors. According to Jeang and Chiang (2012) efficiency starts with scheduling of the case. Attaallah, Elzamzamy, Phelps, Ranganthan, and Vallejo (2015) further state in their study of 44,503 surgical procedures documented in the Electronic Medical Records (EMR), that many specialties inaccurately schedule which leads to inefficiency within the OR. Poor scheduling, such as scheduling a surgeon who is typically still rounding at the time scheduled, can lead to delays in first cases which can cause further delays and increased costs in operating room time and overtime for staff (Phieffer et al., 2016).

OR efficiency is one small portion of the Veteran's Administration Surgical Quality Improvement Program (VASQIP). VASQIP is an enormous program requiring dedicated full-time staff to monitor the program at each Veteran's Administration (VA) hospital. According to Mull et al. (2014) there are many data elements, or data sets, that make up a the VASQIP report. OR efficiency is one of the data sets in the VASQIP report. Operating room efficiency encompasses four data elements, (a) surgical case cancellation, (b) operating room utilization and lag times, (c) operating room first time starts, and (d) operating room nurse overtime.

Operating room utilization is based on how much the room is utilized out of an eight-hour day. Lag time is the room cleaning time and time to prepare the room for the next case. Operating room first time starts are the scheduled first case of the day and the time it starts is supposed to be within five minutes of the scheduled start. Surgical cancellations are any case cancelled on the day of surgery and overtime is any time worked after the scheduled work time end.

At a Veteran's hospital in Central California, it is mandated that all surgical information be input into the Veterans Information Systems and Technology Architecture (VISTA) Surgical Package. As with anything that depends upon human input it is prone to errors. Data can be entered incorrectly, or data not entered at all, which will make the surgical record incomplete. This can lead to lower reimbursement for surgical cases (Jeang & Chiang, 2012).

This system has only one employee dedicated half-time to VASQIP. Mull, Borzecki, Hickson, Itani, and Rosen (2013) state that VASQIP is labor intensive due to the manual methods of data extraction. FitzHenry et al. (2013) state that variations in documentation and areas of documentation further hamper data collection and could benefit from analytics.

Analytics has been defined and used in many ways. Analytics for this review, is defined as the use of logical analysis to determine discrete elements regarding operating room efficiency (Dictionary.com, 2016).

The use of analytics is further supported by Mull et al. (2014) who also describes the complexity of creating reliable analytics to support VASQIP and enhance it. No analytical programs are available to the OR Manager and VASQIP Coordinator to quickly and efficiently monitor for missing data, such as surgical and anesthesia start and end times, or erroneous data, such as incorrect times, being entered the VISTA Surgical Package. With current practices it could be 30 days or more before errors or missing data are detected.

A performance improvement project, which is to improve operating room efficiency by five percent with the use of analytics, was proposed and submitted to the facilities research committee. They determined it was not research but a performance improvement project. See Appendix A for the completed form and statement of support.

Literature Review

Literature provides information on analytics for separate elements of operating room efficiency by not as a whole. No literature was found that described an analytic process to discern operating rooms efficiency meeting the VASQIP data elements for OR efficiency. Some Clinical Information Systems provide dashboards for the status of the operating rooms, but no research has been found that supports these applications as improving operating room efficiency.

Search method and outcome.

A systematic search was conducted, see Appendix B, for studies that were published in English between 2010 and 2017 utilizing five databases: Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, Joanna Biggs Institute Database, and Agency for Healthcare Research and Quality (AHRQ). The key search terms used were *operating room efficiency, analytics operating room efficiency, Veteran's Administration Surgical Quality Improvement Program (VASQIP), VASQIP, and improving operating room efficiency*. The five databases yielded 10987. The search was further refined to include articles that related specifically to analytics and operating room efficiency. This returned thirteen articles selected for this review. The selection of articles regarding overtime in the OR were excluded due to the assumption that an efficient OR would have decreased overtime. So, none were sought for this review. These thirteen articles were then separated by themes as they relate to operating room efficiency. The themes were scheduling, first case on-time, electronic health records and documentation, VASQIP, and perioperative analytics.

Review of literature.

The articles regarding analytics and OR efficiency was narrowly focused, and none covered the four elements noted above related to operating room efficiency as defined by VASQIP. The articles were case studies, mixed-method systematic literature review, prospective study, qualitative study, randomized control trial, and retrospective studies. Each article took a specific part of operating room efficiency. Refer to Appendix B.

Scheduling.

Scheduling covers more than just scheduling the patient for surgery. It involves preparation for the surgery, which can involve many departments, and the surgery itself. Inefficient scheduling can cause bottlenecks and cancellations of surgical cases causing unanticipated costs, inefficient patient care, and lost revenue (Jeang, & Chiang, 2012; Phieffer, 2016). Jeang and Chiang, (2012) further state the unanticipated costs could come from overtime, rescheduling and paying for a surgeon's time, re-preparing the patient for surgery, as well as re-coordinating the surgical case with other departments.

Analytics involving mathematical formulas to improve scheduling of cases has shown some promise, as has the use of Six Sigma tools (Jeang, & Chiang, 2012; Phieffer et al., 2016). Phieffer et al., (2016) describe the Six Sigma tool as steps which are: 1) define, 2) measure, 3) analysis, 4) improvement, 5) control, and 6) fishbone diagram. From this process the project moved into four sequential steps which were: 1) problem mapping, 2) process improvements to preoperative readiness, 3) informatics support improvements, and 4) continuous measurements and feedback. Both series of steps take a focused look at scheduling as one piece of the overall operating room efficiency.

Van Veen-Berkx, Bitter, Kazemier, Scheffer, and Gooszen (2015) took another approach to scheduling through focusing on inter-professional collaboration. The authors created cross-functional teams comprising anesthesiologist, surgeon, OR scheduler, OR nurse, anesthesia nurse, recovery room nurse, and a ward nurse. This study was conducted in six other facilities that were similar to Radbound University Medical Center. The authors cite that inferior inter-professional collaboration might frustrate adequate planning of operative procedures and have a negative impact on patient care delivery.

The authors implemented cross-functional teams to improve inter-professional collaboration in operating room scheduling. Then over time data was collected and analyzed to analyze the effect of the cross-functional teams in improving the scheduling and use of the operating rooms in six university medical centers. Using cross-functional teams showed success in the six facilities (Van Veen-Berkx et al., 2015).

The differences within those facilities described by Van Veen-Berkx et al. (2015) could have been corrected for by using the method described in Tanaka, Lee, Ikai, and Imanaka's (2013) article. Using analysis of administrative data from 224 hospitals in Japan the authors performed four multiple regression analyses. They created four additional indicators which were better predictors of differences in hospitals due to size and manpower. The four indicators were, "(a) the number of operations per OR per month, (b) procedural fees per OR per month, (c) total utilization times per OR per month and (d) total fees per OR per month for each of the models" (Tanaka, Lee, Ikai, & Imanaka, 2013, p.336). These four indicators provide greater validity to identify weaknesses in efficiency within various sized and staffed facilities for comparison.

First case on-time.

Poor or inefficient scheduling can lead to delays of the first case in the OR. Communication seems to be the biggest cause in delays of the first case (Schuster et al., 2013). Communication within multidisciplinary teams and sometimes between the hospital wards and OR have led to delays of the first case. Patients not transferred to the OR on time, specialties not present in a timely manner, and scheduling of instruments have all been causes of delays (Phieffer et al., 2016; Schuster et al., 2013). Schuster et al., (2013) stated that 70% of the general surgery and trauma/orthopedic cases had a delayed incision time from their 22-hospital study. This further shows that case types may play a role.

Analytics coupled to dashboards have shown promise in diminishing this frequent problem in ORs. Hassanain, Zamakhshary, Farhat, and Al-Badr (2016) demonstrated this in their “Lean-based” intervention. Lean is a set of operating philosophies and methods that help create a maximum value for patients by reducing waste and waits. Hassanain et al., intervention was comprised of the following: a) creation of visual dashboards that enable starting the first case on time; b) use of computerized surgical list management; c) optimization of time allocation; d) development of an operating model with policies and procedures for the pre-anesthesia clinic; e) creation of a governance structure with policies and procedures for day surgeries. The goal was to improve on-time surgery start, surgical list management, OR schedule, and the pre-anesthesia clinic. The measurable outcomes were first case on-time start, OR utilization, percent of overrun cases, average weekly procedure volume, and room turnover times. According to the authors significant improvement ranged from 5% - 55%, in 8 of the 12 hospitals in first case on-time starts. OR utilization also improved in 8 of the 12 hospitals. 7 of the 12 hospitals showed improvement in overrun cases. Volume and turnover times showed no statistical improvement.

Electronic health records and documentation.

Electronic health records (EHR) have all but replaced paper records. Fewer hospitals are still relying on the paper record. This provides more data to be captured and readily analyzed for a myriad of reasons such as billing and performance improvement programs.

One area of operating room efficiency is scheduled times versus actual times. This will show a direct correlation of efficiency (Attaallah, Elzamzamy, Phelps, Ranganthan, & Vallejo, 2016). The EHR provides data in a retrospective manner (Attaallah et al., 2016). That is the case that is scheduled then performed and documented in the EHR. Also, the EHR is only as good as the documentation (Wang, Hailey, & Yu 2011). Missing or inaccurate data will skew the results.

VASQIP.

Good documentation provides rich retrospective data for the VASQIP report. Fitzhenry et al. (2013) used electronic algorithms and natural language processing to harvest key structured terms in search of documentation regarding nine postoperative complications. Mull et al. (2013) conducted a retrospective study of VASQIP data to measure criterion data for 5 of the 10 Agency for Healthcare Research and Quality (AHRQ) Patient Safety Indicators (PSI) which are, (a) postoperative physiologic and metabolic derangement (PMD), (b) postoperative respiratory failure, (c) pulmonary embolism and deep vein thrombosis, (d) postoperative sepsis, (e) postoperative wound dehiscence, and found that the validity was moderate at best due to coding errors (Mull et al., 2013). Postoperative complications may be linked to an inefficient operating room (Jeang & Chiang, 2012; Phieffer et al., 2016)

Perioperative analytics.

Analytics can show inefficiencies and efficiency within surgical services. Stiefel and Greenfield (2014) state that the biggest indicator of operating room efficiency is operating room utilization. Rempfer (2015) states that using analytics can reduce the costs of operating rooms. Using data to meet goals must be structured so the end user does not become overwhelmed (Rempfer, 2015).

Rationale

Analytics can show inefficiencies and efficiency in operating room efficiency. OR efficiency is defined by quantitatively measuring: a) missing or erroneous data in the surgical chart, b) cancellations of surgical cases on day of surgery, c) variances in time of scheduled versus actual surgical start times and ends, d) on-time starts, e) operating room utilization based on actual use out of an eight-hour day, and f) overtime which is any time worked after end of scheduled shift or before schedule shift start.

Presenting the retrieved data so that it is usable and will not overwhelm the end user is an imperative (Hovlid & Bukve, 2014). So, the data must be presented in a manner the end user can relate to. Hovlid and Bukve state the context and relationship of the information with the goal of improvement strategy is important. Towards those goals the reports were broken down to three records. The first OR Times, showed all the OR times for the surgical case and data utilized for billing. The second record OR Efficiency showed variance between scheduled start and end times against actual start and end times. This record also included the on-time starts. The last record titled, OR Utilization, showed OR utilization by room. This record also showed OR overtime room and total overtime for the month. All reports were run by calendar month.

Conceptual framework.

The framework being utilized for this project is a conceptual framework. It is comprised of elements of transitions theory and complexity theory. Together, the two bring human elements into analytics which can unfortunately be perceived as just numbers and not people. It is these human elements, such as scheduling, movement through pre-operative, peri-operative, and post-operative phases, this author is interested in because the human element is most error prone and needs to be assessed and monitored.

Transitions theory.

Over 50 years ago, Meleis' s middle-range theory, about transitions, was published (Im, 2014). Since then, transitions theory has been utilized in two ways: a) as an individual theory and b) incorporated into situation-specific theories (Im, 2014). Im (2014) further states, in her article, that transition is "defined as passage of one life phase, condition, or status to another" (p.20). Meleis (2007) defines that transition as "a change in health status, role relationship, expectations, or abilities" (p.470).

Through life change happens, and it is the transition from one phase of the change to the next this theory explores, describes, and predicts. Transition requires the person or institution to incorporate new knowledge.

Another assumption of this theory is that nursing plays a central role. The nursing process is used to facilitate a smooth and successful transition (Im, 2014). The major concepts of the transitions theory are "(a) types and patterns of transitions, (b) properties of transition experiences, (c) transition condition, (d) process indicators, (e) outcome indicators, (f) nursing therapeutics" (Im, 2014, p.21). A previous version of transitions theory was written in Im's (2011) article. It is a much simpler version of the transitions concepts which included (a) nature of the transition, (b) transitions condition, (c) patterns of response, and (d) nursing therapeutics (p.279).

The nature of a transition can be simple or complex in nursing. It can be the transition from pre-operative too peri-operative which can be as simple as a movement from one area to another or very complex with many interactions (Im, 2014).

The condition and process of transition for nursing encompasses the patient in their entirety. It is a holistic process of assessing the patients personal, community, and societal conditions (Im, 2014). These conditions affect the patient's movement through pre, peri, and post-operative processes.

Im (2014) defines patterns of response as measurable process indicators. These are indicators of health and vulnerability and risk. Operating room efficiency plays a significant part in these indicators. An inefficient operating room can increase vulnerability and risk as well as play a role in negative health indicators (Jeang & Chiang, 2012). These vulnerabilities manifest in low staff morale, increase expenditures, and reduce medical quality.

Nursing therapeutics as defined by Im (2014) is the nursing assessment of the patient in relationship to 'readiness to transition' (p. 21). This is not a well-defined concept as per Im (2014). For this authors purposes readiness to transition is the formal and informal assessment of the patient at every step in the pre, peri, and post-operative process.

Complexity theory.

Thompson, Fazio, Kustra, Patrick, and Stanley (2016) state the use of complexity theory has not been consistent in its conceptualization therefore, generalization is difficult. What is consistent is that complexity theory offers a view of studying complex systems. In a system the individual components are not as important so much as the relationship between them and the interactions of the system components that result in specific behavior (Thompson et al., 2016).

Scott and Van Norman (2009) state there are three guiding principles in complexity theory that promote adaptability and flexibility to sustain work or change. They are (a) “diverse interaction and self-organization are critical for evolution and adaptation, (b) complex adaptive systems cannot be highly efficient and survive in a complex dynamic environment, and (c) effective structures are essential” (p. 111).

Diverse interactions and self-organization lead to diversity and creative processes in nursing. These can be work-arounds which must be captured, measured, and if unsafe stopped. Nursing leaders must be comfortable with creativity which comes from complex adaptive systems. The work-arounds or new processes suggested might be more efficient and safer than existing methods. Nursing staff must be comfortable with structure such as quality measures, chain-of-command, policies and procedures that communication from bottom-up flows just as freely as from top-down (Scott & Van Norman, 2009).

As stated previously a conceptual framework is being utilized. The portion of transitions theory being utilized is the mapping and measuring of the change in practice. It is the process and outcomes indicators that will be measured. While, the complexity theory helps map and explain the relationships between the variables, complexity theory also helps explain the interactions between the variables. In theory, workflow should flow regularly and evenly but, it does not. It is these uneven workflows or interruptions to workflow for which applying complexity theory will help provide guidance in mapping and measuring these processes.

Aim

Arndt (2017) wrote, “VA healthcare will remain designated high-risk by GAO until it sufficiently addresses its unclear policies, process variability and other mismanagement issues” (p. 1). Operating room inefficiency can lead to increased wait times for procedures further putting patients at risk. The purpose of the project was to use analytics and evaluations to improve the operating room efficiency, as previously defined by this author, by five percent. The authors definition of OR efficiency differs from VASQIP.

Replicating the VASQIP data is not beneficial. VASQIP data can be manipulated to improve scores. An example of this manipulation is to not schedule high risk patients. High risk patients are those with a high noncompliance in following procedure and not showing up for appointments and scheduled tests. By not scheduling theses high risk patients for surgery the cancellations will decrease. Another method to improve scores around OR utilization is to close rooms for certain periods of time so OR utilization appears higher than it really is. So, a more holistic approach looked at overall data not just VASQIP.

The goal was by December 1, 2016 analytics would be created and provided to the OR Manager and VASQIP Coordinator to improve OR efficiency by 5%. These analytics were provided for six months, ending June 30, 2017. To achieve this aim, the data elements for (a) surgical case cancellation, (b) operating room utilization, (c) operating room first time starts, (d) operating room nurse overtime, must be identified and defined. Then these data elements must be mapped to how they are documented, where they are documented, and where the data lies within a database and which database has these elements. Once these are known then the query can be built, tested, and validated.

Jeang and Chiang (2012) state that OR efficiency decreases cost, improves quality, and safety. Van Veen-Berkx, Bitter, Kazemier, Scheffer, and Gooszen (2015) further states that OR efficiency increases patient satisfaction.

Method

Context

The stakeholders were the patient, Chief of Staff, Chief of Surgery, Chief of Medicine, Environmental Management Systems, Nurse Executive, OR Manager, VASQIP Coordinators, surgical nurses, surgical scheduler, and nurse informaticist. The Chief of Staff is ultimately responsible for all medical and surgical processes implemented and performed in this facility. Therefore, the Chief of Staff gives final approval for any changes or enhancements to current practices.

The Chief of Surgery, Chief of Medicine, OR Manager, surgical nurses, and surgical scheduler all have a vested in interest in working collaboratively. van Veen-Berkx et al. (2015) state that multidisciplinary collaboration has a positive impact on OR efficiency. Although the Chief of Surgery handles the OR theater and all that happens within it is through a multidisciplinary collaboration that efficiency will be achieved.

The nurse informaticist must develop or have someone develop the query implemented. The project development follows the System Development Life Cycle, see Appendix H. It is also the nurse informaticist responsibility to gain access to the databases with the Chief of Staff's approval and support.

Buy-in was the most important part of bringing about change and improvements. Analytics alone cannot bring about change. Analytics can only provide the information to assist in making informed decisions to bring about the desired improvements.

Intervention

The process for gathering the data was to run three separate Veterans Information System Technology Architecture (VISTA) Fileman queries. VISTA is a nationwide system and the EHR for the Veteran's Health Administration. VISTA is in Massachusetts General Hospital Utility Multi-Programming System (MUMPS) which is a general-purpose computer language. Fileman is a query system for VISTA data.

The three queries are related in that all the data comes from the VISTA surgical package. The second query builds on the first. The third is a standalone query.

All three VISTA Fileman queries are set by date first then by last name for the first two queries. The third was set by date then by operating room. The VISTA Fileman queries were developed from scratch. This author worked with a Massachusetts General Hospital Utility Multi-Programming System MUMPS programmer to develop the queries and methods to transfer the results into excel then SPSS for descriptive analysis.

The first query sorts by patient's name, surgical service, surgeon, procedure, case type, operating room number, scheduled start time, scheduled end time, in-room time, anesthesia start time, anesthesia end time, pacu start time, and pacu end time. This query's purpose was to determine record completeness and potential errors in the data. To check completeness, one only must look for empty spaces in each column and row. Errors detection is a visual inspection of each data element for such details as did the case end before it started. Did the case number match what was scheduled then documented?

The second query was set to determine actual start times. The second query was ordered by scheduled start time, scheduled end time, in-room time, actual start time, actual end time and on-time starts. The time differences between start and actual are computed and the scheduled end and actual end times. If the times are within five minutes of each then they are counted as on time. Anything over five minutes is considered as not on-time, which can be early or late. Early time was represented as a negative number and late as a positive number. The actual count of on-times was represented as a 1 and any other time was a 0.

The third query is set to determine actual operating room utilization. OR utilization is defined by the time the room is utilized in the normal eight-hour shift. Time is subtracted for OR cleaning.

The formula is total time OR room utilized for that day divided by the difference of eight hours minus cleaning time. All time is represented in minutes. An example is XXX/(480-XX). The third query is ordered by patient in room and patient out of room times. The purpose is compute actual times rooms are being utilized. This query also picks up overtime for the ORs.

The time difference between actual and scheduled were entered into IBM SPSS Statistics 24 for descriptive analysis. The data entered into IBM SPSS 24 was to calculate variance between scheduled starts, ends, and actual starts and ends plus the number of on-time starts per month. The data entered was from December 2016 through June 2017. December 2016 was the baseline month.

The measurement of efficiency is the improvement in data from Table 1 by 5%. This is an overall decrease by 5% in incorrect or missing data, surgical cancellations, surgery start and end range, and overtime. It is also a 5% increase in on-time starts and OR utilization.

Gap analysis.

Current practice is to utilize VASQIP data which is 90 days retrospective. If data is in error or missing that patient's record goes against the site. Each VA hospital is compared against like facilities based upon VASQIP data and other measures. An incomplete or record found to have errors is counted in a negative way for the facility. Please refer to Table 1 to review.

Surgical cancellations, on the day of surgery, is another measure that can count against the facility. This data can be manipulated by simply not scheduling the patient if they are at risk for being noncompliant with medications or even showing up. If they comply with medications and show up, then they are just added on to that day's schedule.

Only the first case starts of the day times are tracked. The rest of the scheduled cases start times are not tracked. Also of note the same day first case of the day start times are not tracked.

Scheduled times in and out of OR are tracked and analyzed for lag times. There is an allotted amount of time allocated to clean an OR room based upon type of case. These times are not tracked due to environmental cleaning staff not having the ability to input data. Also, not tracked is the time difference between OR room cleaning completion until next case.

OR utilization is tracked but data is easily manipulated. An example is to close a room in the scheduling package so that the numbers reported in VASQIP are higher. Real time overall utilization is not tracked. Real time OR utilization is the amount of time each room is utilized for the eight-hour period.

All overtime in the facility is accurately tracked by multiple groups and reported to the director of the facility daily, monthly, quarterly, and annually. It is reported by service and area so that everyone knows if they are in or out of the budgeted allowance for overtime.

Gant.

The project in Appendix C was broken down into (a) research, (b) obtaining access to database, (c) identifying where the data elements lie within the database tables, (d) writing the query, (e) testing and validating the query, and (f) rolling out the analytics. Some processes overlapped and did not conflict with other processes. During the query building process, it was necessary to build three queries to accomplish the task.

See Appendices D and E for workflow and communication matrix. The Nurse Informaticist was involved in every phase and led the project. In the development phase the Nurse Informaticist worked with the MUMPS programmer for the technical side and the VASQIP Coordinator for the specific data elements. Validation was done with the MUMPS programmer for tweaking and refining the query Validation was done with the VASQIP Coordinator because the data being extracted was correct.

Initially communication was constant then slowed down to an as needed basis. Reports were sent monthly once the project started for assessment by the Chief of Surgery, the Surgical Manager, and the VASQIP Coordinator. The Nurse Executive and Associate Nurse Executive was also included in the reports sent.

Swot.

The overriding theme of the project was increasing the OR efficiency using analytics. The strengths, as shown in Appendix F, in this analytic program is that the data can be drilled down to the individual practitioner. If a practitioner is identified that they can never make the first case on time, then data may help identify specific issues related to that practitioner or those cases. Also, data can be provided for specific surgical case types to help the scheduler be more efficient in scheduling.

The weakness in this type of analytics is that initially it must be run manually to validate its accuracy and to identify any quirks. Automation was not developed after the start-up of the project until after the project's completion. Manually running the analytics took time away from other projects for the person running the analytics. Literature has shown that data manually entered by humans is problematic. Inadvertent mistyping of numbers is a common problem which would throw the analytics off (Wang et al., 2011).

The biggest weakness was being dependent upon an outsider, which is a contracted firm from outside of the facility’s network, assisting in building the analytic tool and maintaining it. This incurred an initial cost and contracting which took time. To overcome this, it became in the facilities best interest to develop the skill set from within the facility. This created another threat from staff turn-over though and through additional workloads being assigned to the staff member.

The opportunity to increase operating room efficiency outweighs any weakness or threat. The increased operating room efficiency should translate into increased revenue, staff satisfaction, and patient satisfaction. It should also decrease adverse patient events and cost for the operating room (Mull et al., 2014).

Another threat is the threat of VISTA changes to the surgical package and subsequently how the data lays in the database is real. These changes can change established links and data entry points and data reference points. This has been brought up at the national level and is being addressed because of numerous programs these updates break. Although these updates usually increase efficiency there is always that potential for disruptive updates.

To mitigate updates to the VISTA surgical package a test workstation needs to be created to test updates before pushing out. This will identify any disruptions and allow time to develop workarounds or correct the update prior to pushing them out.

Lastly the purpose of this tool is to improve services and increase efficiency. The tool can only show problem areas. Staff utilizing the tool properly can identify specific opportunities for improvement and create processes to improve overall efficiency.

That it can be perceived as a punishment tool and that it can be turned into a punishment tool is very real. Through education of all concerned and comprehensive policies this threat can be minimized.

Return on investment.

The total cost was $48,360.00 with a breakdown in Appendix H. This is based upon the cost for the Informatics RN dedicating 200 man-hours to co-develop the analytics. The budget also included a Massachusetts General Hospital Utility Multi-Programming System (MUMPS) programmer. Their work took two weeks. The VASQIP Coordinator also worked for a total of two week.

Reporting requirements were to the Nurse Executive, OR Nurse Manager and the VASQIP Coordinator. Man-hours being dedicated to the project were justified through progress and positive results in the project. As stated previously the analytics was manually run throughout the entire project. This took most of the Nurse Informaticist's time plus some time from the OR Nurse Manager and VASQIP Coordinator to discern true benefit of the project.

Cost benefit analysis.

The project took one full time nurse informaticist four months to develop and test the analytic program. The nurse informatics had other duties, so the development took 440 hours of their time which equals $25,080.00. The nurse informaticist required a Massachusetts General Hospital Utility Multi-Programming System (MUMPS) programmer to assist in the development of the analytics. The cost was for 80 hours which equaled $4,400.00. The VASQIP coordinator was utilized off and on during the development and subsequent implementation of the project for a total of 80 hours which equaled $5200.00. Once the project was implemented, the nurse informaticist spent the first week of each month running and compiling the analytics. This took another 240 hours at a cost of $13,680.00. The total cost for the project was $48,360.00. Refer to Appendix G.

The project was written and run so that only full time VA employees were utilized. Their jobs just shifted so no additional cost would be incurred by the facility. The goal is to save money through greater efficiency. No outside sources were utilized.

Attaallah, et al. (2016) and Rempfer (2015) both state one of the biggest cost to a facility is its surgical department. They also state that the surgical department can be its biggest revenue generators. The facility has a budget of $212 million dollars (VA, 2016). If one-third of the budget goes to the surgical department that is $69,960,000.00. A five percent increase in efficiency could save and/or generate $3,498,000.00.

Assessment

Three analytical queries were run in VISTA Fileman. These were then transferred into Excel and expanded. The results were compiled and verified. The verification process was with managers and VASQIP coordinators. Then some of the data was input and run through IBM SPSS 24 descriptive analytics to determine if the analytics was helping the processes for operating room efficiency.

Each month the data was then assessed against the baseline data for measurements, see Table 1. The baseline data is from the month of December 2016. It consists of the raw numbers and percentages of (a) incorrect or missing data in surgical record, (b) surgical cancellations, (c) surgery start range, (d) surgery end range, (e) on-time starts, (f) overall OR utilization, and (g) overtime.

The data was then sent to the OR surgical manager, Chief of Surgery, case manager in charge of the surgical scheduler, Nurse Executive and Associate Nurse Executive. This data was sent in raw form, so recipients could drill down if necessary for their assessments.

Measures

The analytic results were broken down into three excel spreadsheets. These spreadsheets are not included in this paper due to confidential patient information. The first was titled OR Times. This spreadsheet contained the patient's name, surgery specialty, surgeon, case schedule type, scheduled procedure, OR room, scheduled start time, scheduled end time, in-room time, anesthesia starts, anesthesia end, PACU start, and PACU end. This first excel spreadsheet was used to check for completeness, errors, and surgical cancellations.

The second spreadsheet was titled OR efficiency. The spreadsheet contained the patient's name, surgery specialty, surgeon, case schedule type, scheduled procedure, OR room, scheduled start time, scheduled end time, in-room time, actual start time, actual end time, time difference between actual start and scheduled start, time difference between actual end and scheduled end, and actual on-time starts. This spreadsheet was used to gather data on the efficiency of surgical scheduling and on-time starts for all cases.

The third spreadsheet was titled OR utilization. The spread sheet contained the OR room, actual start time, actual end time, total time of case, total time of room use for 8 hours, average cleaning time per case, formula for percent, daily percentage of use, OR overtime, OR room percentage per month, average of all OR utilization percentage, and cumulative OR overtime. This page was used to determine OR utilization and OR overtime.

See Table 1 for baseline data. The performance improvements goal was to bring about a five percent improvement in overall OR efficiency. This was measured by: (a) incorrect or missing data in surgical record which is 46 errors or missing data elements out of 213 records for 21.60%; (b) surgical cancellations which equal 6 out of 213 for 2.82%; (c) Time difference range between scheduled start time and actual start time in minutes which equals 268 minutes (-140 - 128); (d) Time difference range between scheduled end time and actual end time in minutes which equals 351 minutes (-195 – 156); (e) Actual on-time starts which is 9 out of 213 for 4.22%; (f) Overall OR utilization 53.74%; (g) OR overtime 1,347 minutes for the month.

All data was validated through OR schedule in 24-hour report, OR manager, VASQIP manager, Anesthesia, and PACU manager. Erroneous and missing data was reported out first to ensure that it was erroneous or missing.

Analysis

The data was compared to baseline then previous months data to identify trends. The themes are those previously mentioned which are: missing or incorrect data, surgical cancellations, time differences in start, time differences in end, actual number of on-time starts, OR utilizations, and OR overtime. The time differences for start and end with on-time starts were entered IBM SPSS 24 for descriptive analytics. This facilitated an easier detection of trends.

Ethical Considerations

The facilities research committee deemed that this was nonresearch, see Appendix A, and permission was given to proceed with the project. The research committee deemed this as a performance improvement project. Further permission and support was sought through the Nurse Executive and OR Nurse manager. Patient information was handled in accordance with VA's *Handbook 6500*.

Results

Results

December 2016 was the bench mark month. This was the month prior to the start of the project. The percentage for incorrect or missing data in surgical record was 1.66% or 46 errors and missing data elements out of 2769 data elements**.** The process to determine errors or missing data was to look on report 1 and visually determine missing elements and scan for errors such as surgery ending before it started. Refer to Table 1.

The number of errors per month decreased from a top in January, as shown in figure 1, of 66/2691, or 2.45%, to 22/2704, or 0.81% in June. Refer to Table 2 for numbers per month.

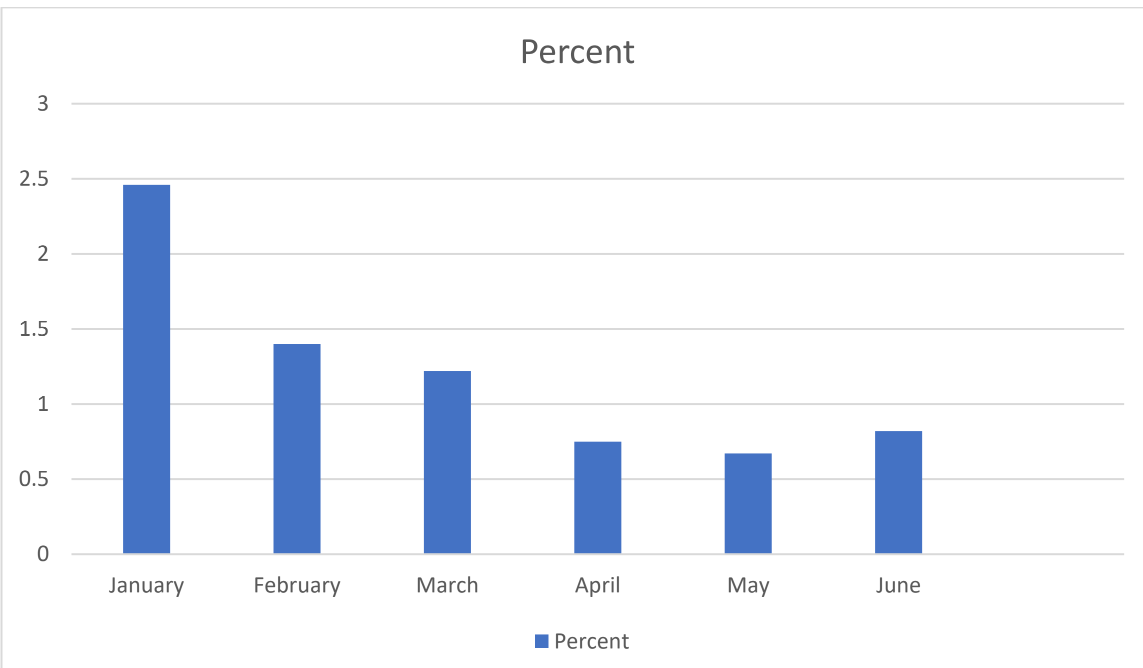

Figure 1

The benchmark for surgical cancellations is 6/213 or 2.82%. Figure 2 shows the data in January the data was 7/207 or 3.38%. In June the cancellation rate was 3.86% or 8/207. Refer to Table 3. The data did not fluctuate that much.

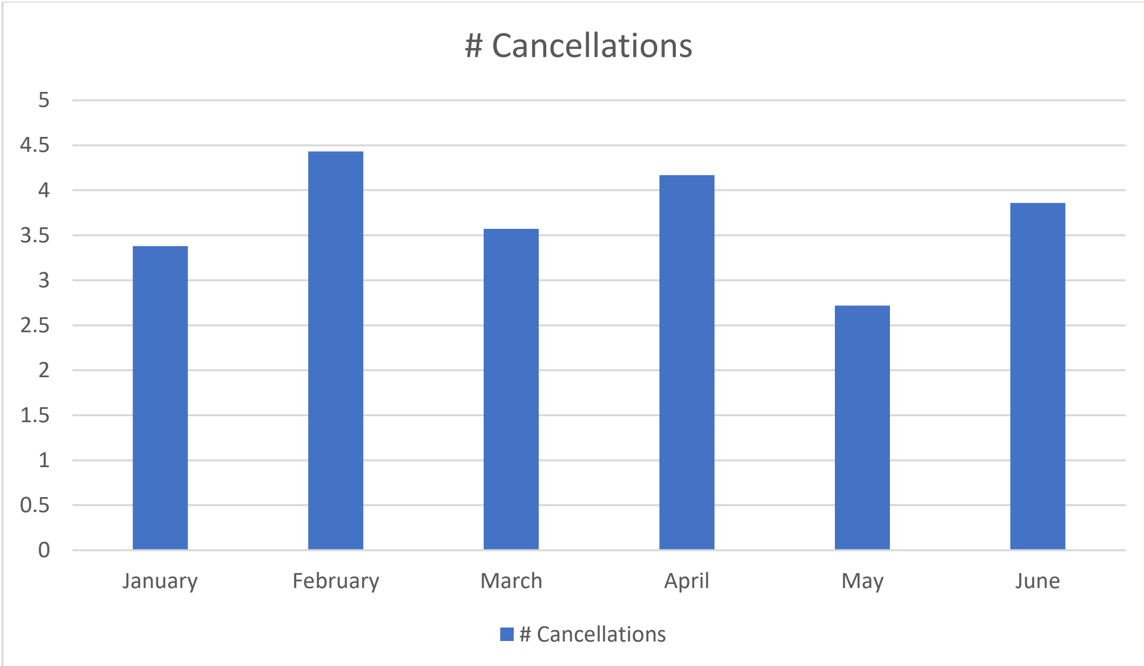

Figure 2

In Tables 4 and 5 are the variance data sets of scheduled start and end times versus actual start and end times. In the descriptive statistics *Range* was utilized because it showed more dramatically the variances from scheduled times to actual times. The numbers represent minutes. Early is represented as a negative number and late as a positive number.

The ranges of sets surgery start, and surgery end fluctuated. The range for surgery start for January was 438 minutes. The range peaked in February at 722 minutes then dropped in March to 384 minutes. Then the time range increased to 657 minutes in April and further increased in May to 693 minutes. A dramatic decrease in June to 254 minutes. Baseline range was 268 minutes.

The range for surgery end in January was 371 minutes and peaking in February at 798 minutes. In March there was a decrease in range time to 368 minutes. April and May showed increase to 448 and 618 minutes respectively. And then a drop to 405 minutes for June's range.

Baseline was 351 minutes. The use of analytics did not improve scheduled start/end to actual start/end time variance.

Table 6 shows the On-time starts. Figure 3 shows the modest increase from 19 in January to 22 in June. February, March, and April showed decrease to 16, 15, 9 respectively. May jumped to 24 on-time starts with a decrease to 22 in June. Baseline was 9 on-time starts.

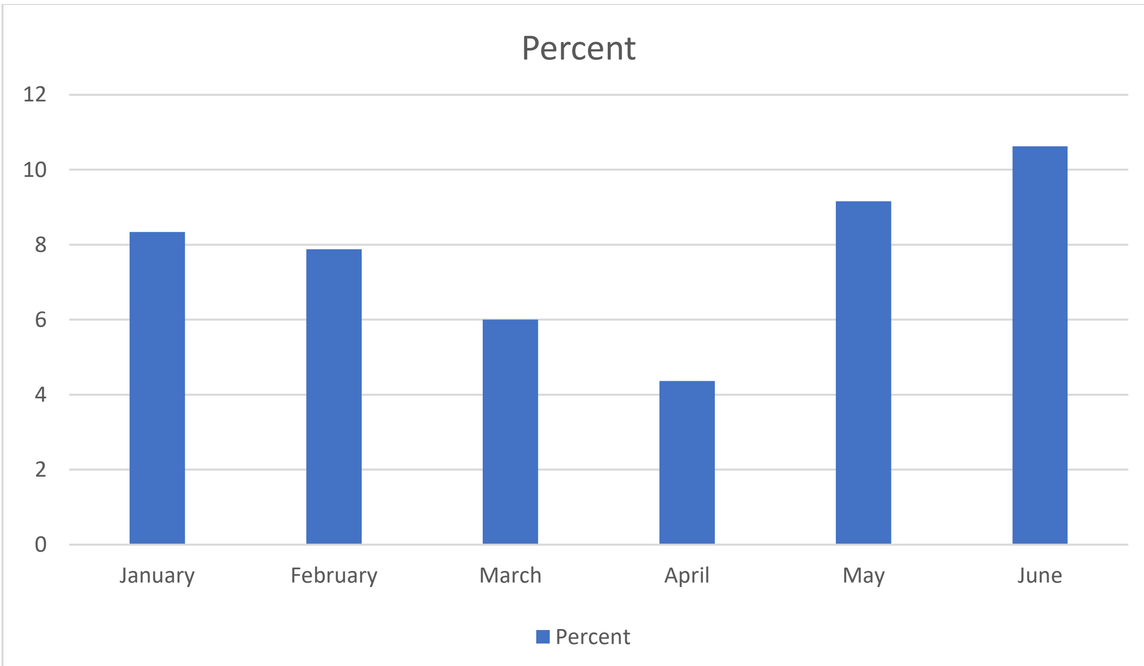

Figure 3.

Table 7 shows fluctuation in OR utilization. There had been an upward trend from January to May from 64.60% to 72.42% then June fell off to 58.83% Baseline was 53.74%.

Table 8 shows overtime for operating rooms. In each operating room, there is at a minimum a surgeon, first assistant, scrub nurse, circulating nurse, and anesthesia. There can also be an anesthesia technician present. Figure 4 shows that in January there were 1666 minutes then an increase to 2551 for the month of February. March and April decrease to 2189 and 1490 minutes respectively. May has a dramatic jump to 3488 minutes and then a droop to 1859 minutes in June. Baseline overtime was 1347 minutes. The use of analytics did not decrease overtime.

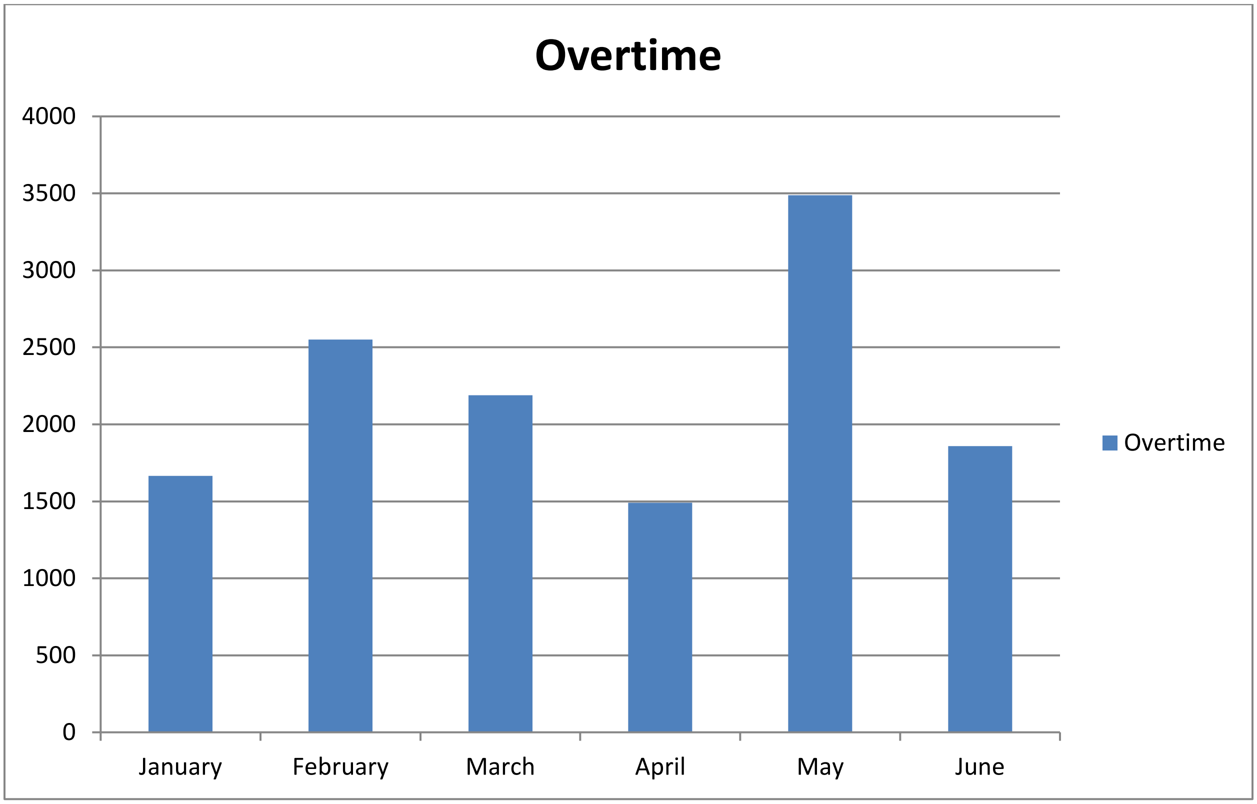

Figure 4.

Discussion

Errors.

The number of missing or incorrect data elements dropped from January to June. Once more attention was placed on the charts for correctness and completeness the records improved then stabilized. Further investigation discovered a problem in the HL7 and CIS interface which was causing the over-writing of some data. An example is the surgery ending before it started. This was not resolved until the very end of the project. Further queries would have to be run to determine if error rate has dropped even further.

Cancellations.

The use of analytics had no impact on same-day surgical cancellations. Cancellations were caused by various things such as staffing shortages, lack of beds to admit patients to, and ordered surgical instruments for the case not ready. The number of cancellations remained constant. Staffing shortages from retirements to sick calls to annual leave remained constant through the project as well as the shortage of inpatient beds to admit patients. Daily meetings with the executive leadership by the OR Surgical Manager and the Chief of Surgery expedited the hiring process for new employees but could not alleviate the bed shortage. The instrument issue was dealt with promptly.

The overall theme that presented itself was the shortage of beds to admit patients. All other issues could be worked around in time. Executive leadership is working on this issue. Reducing cancellations will depend upon creating and opening of new beds to admit patients to.

Scheduling.

Phieffer et al., (2016) and Schuster et al., (2013) state in their respective papers that communication is a big component of efficient surgical scheduling. Pfeiffer's et al (2016) identified a unique barrier. It was the barrier of "culture of inefficiency" (p.7). The established inefficiency had taken on its own culture and was difficult for the authors to overcome. This proved to be true in this facility.

For an example if the first case of the day had to be moved to the last case of the day this was not always communicated with the scheduler, so the schedule could be corrected. It is possible that some variance could be attributed to the HL7 and CIS interface, but not all the variances. There was no focus placed on fixing scheduling differences.

The surgical start and end fluctuations seemed to correlate in variance range each month. There was no influence on this happenstance by the analytics. The only influences on the schedule were in getting the case scheduled and the case completed on the day of the schedule.

When it was discovered there was an issue with the HL7 and CIS interface those corrupted times were removed from the data to not influence or corrupt the data. The times were entered as zero to not count.

Starts and ends.

On-time starts were a low percentage. Scheduling worked against this plus the focus was on the first case of the day being on time. The rest not so much. On-time starts, and On-time ends were rare but increasing. Once it was realized that all cases were being tracked there was an effort, but as previously stated scheduling worked against them.

Utilization.

OR utilization increased from the start of the project in January to May the dropped in June. Staffing shortages plus sterile processing equipment going down in June may have contributed to the decrease. The study would have needed to continue for another two months to determine and validate this possibility.

At the start of the project surgical services started total joints. This was a new service for the facility and added number of cases per month to the surgical services. This was an enhancement for the facility and added complexity. This addition was impressive with the staffing shortage and bed shortage.

Overtime.

Analytics played no part in the overtime. Scheduling variance did not decrease and OR utilization improved some but not enough to have an impact on overtime. What played the most into overtime was emergent cases off tours overlapping with normal tours. Another factor for overtime was being short staffed so utilizing less rooms and extending the surgeries to off tours. Another factor was sterile processing equipment failing and time was extended for processing of instruments.

Summary

Even though the overall aim of this study was not achieved, an overall 5% improvement, there were some interesting findings. First was the decrease in errors and missing data in surgical data. This led to the discovery of the HL7 and CIS interface problem. It had not been believed that a CIS could overwrite times in the VISTA surgical package. There is no a process in place to review all surgical records for completeness and accuracy.

There was an improvement in on-time starts. But there was no significant improvement in adherence to schedule. The variance range for both starts and ends appeared to follow a sine wave and it did not appear that presenting the analytics monthly to the surgical leadership had any impact on the results.

Same day surgical cancellations were more impacted by lack of beds than anything else. Staffing shortages came in second for cause of surgical cancellation. Repeating the study after these areas are addressed would be interesting.

On-time starts did improve. The analytics showed the actuals and there was an effort to start cases on time, but the scheduling was complicated by poor communication within the department between providers and scheduler.

OR utilizations did improve. The question is if it was due to just analytics or the increase in number of cases. Once scheduling is addressed then it would be again be interesting to replicate the project.

Overtime can only be truly studied once the complicating factors such as not enough admit beds, staffing shortages, and scheduling are addressed. Emergency cases play a big factor on overtime as well. Analytics has the potential to highlight opportunities to decrease overtime, but it was not demonstrated in this project.

Interpretation

The intervention was the running of the analytics and presenting the data monthly to the surgical leadership and answering any questions. Phieffer et al. (2016) findings of “culture of inefficiency” relates for closely to this project.

Consent for the project did not equal buy-in for the project. There was buy-in for areas of record accuracy and on-time starts. OR utilization was also important to them.

Analytics alone can never solve anything. Data for data sake is wasting time and effort. Buy-in and a desire for change along with effective communication must be present to make analytics beneficial (Phieffer et al., 2016; Schuster et al., 2013).

Implications for the facility could be an increase in difficulty to expand services. Without an increase in efficiency the surgical service is fighting itself to achieve any expansions.

A surprise finding on impact OR efficiency is amount of available beds to admit to. A shortage of beds had a negative impact on scheduling as well as surgical cancellations.

Limitations

Findings are based on a single project with one person working primarily on the project. There was little if any buy-in by the surgical services. There was bias upon the part of the project developer that the data would be utilized to improve services and achieve greater efficiency within the department.

The strength of the project was that the data was solid and proven to be accurate. Other facilities viewed the data, data gathering process, and overall analytics. The queries developed have been adopted by the network and will start to be utilized by the network by the end of the year.

Conclusions

Increasing efficiency in any area needs high buy-in. Communication needs to be clearly understood by all participants. Analytics alone cannot solve any problem. They may highlight them but if the data is ignored then the process is frustrating and will not bring about any desired change.

The data showed deficiencies and some areas did improve but overall there was no great improvement or movement towards improvements. The project would need to be increased and become more sophisticated to tease out all the threads that contributed to positive and negative impacts on the desired outcomes.

There is value in analytics and improving efficiency in the surgical department. But there is greater value in understanding all that impacts a surgical department at any given moment. There may be a desire for change and improvement but no ability due to constraining factors.

Funding

No funding received for the project.

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Table 1

Operating Room Efficiency Gap Analysis

Current State

Description of area being analyzed	Current percentage	Gaps Identified	Actions to address gaps
Incorrect or missing data in surgical record	46/2769 1.66%	Current process is through coding and VASQIP – can be months before errors detected	Create analytics to capture data
Surgical cancellations	6/213 2.82%	Currently tracked but data can be manipulated	Create analytics to capture data
Surgery Start range	268 (-140 - 128)	Not currently tracked	Create analytics to capture data
Surgery End range	351 (-195 – 156)	Not currently tracked	Create analytics to capture data
On-time starts (includes first case)	9/213 4.22%	Only 1st case tracked	Create analytics to capture data
Overall OR utilization	53.74%	Tracked but data can be manipulated through exclusions	Create analytics to capture data
Overtime	1347	Currently tracked	Create analytics to capture data

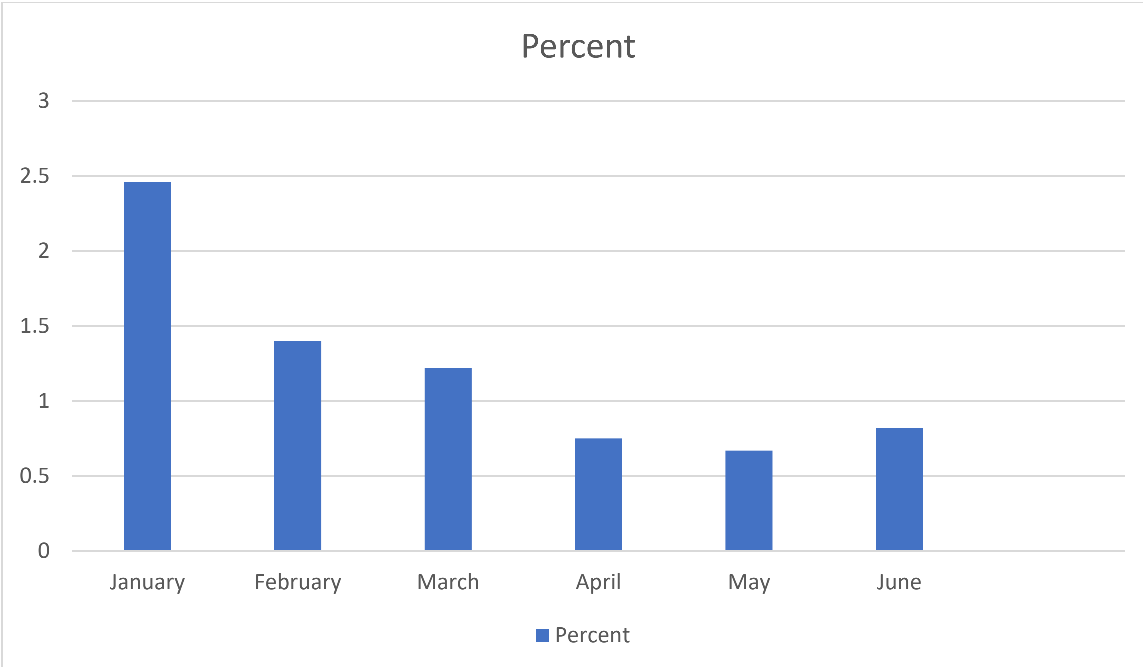
Current practice is to utilize VASQIP data which is 90 days retrospective. If data is found to be in error or missing that patient goes against the site.

Surgical cancellations also go against the facility. This data can be manipulated by simply not scheduling the patient if they are at risk for being noncompliant with medications or even showing up. If they are compliant with medications and show up, then they are just added on.

Only the first case of the day time is tracked. The rest of the schedule is not tracked. Scheduled case times are variant for same type of case. So scheduled times in and out OR are not tracked or analyzed.

Table 2

Error Rate

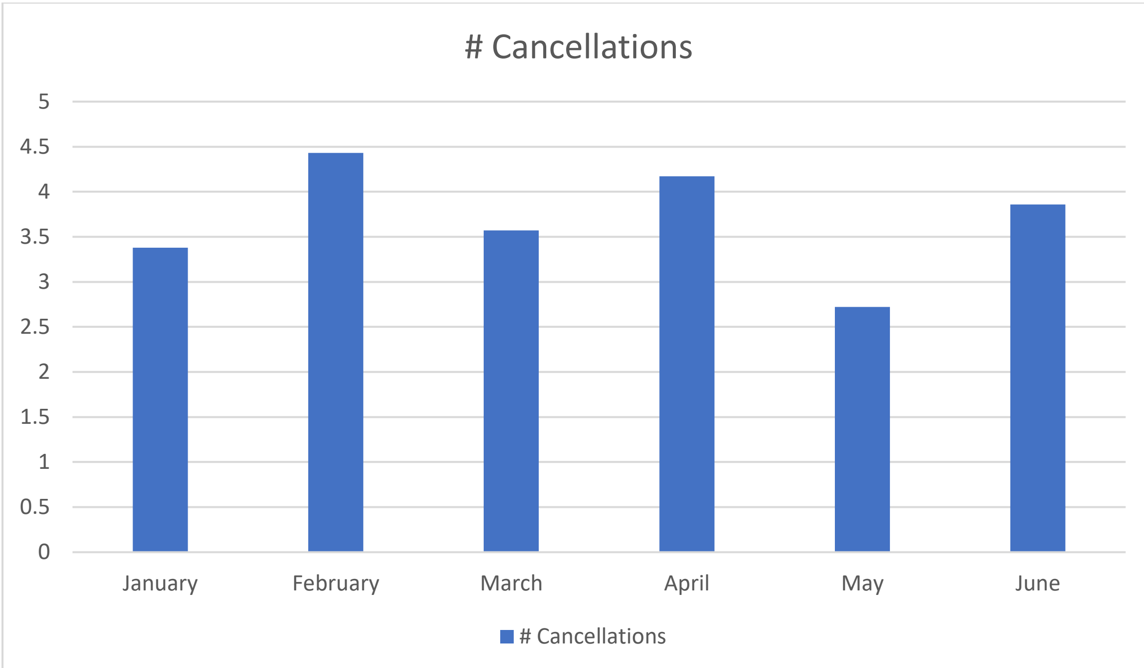


Month	**Errors**	**Percent**
January	66/2678	2.46%
February	37/2639	1.40%
March	40/3276	1.22%
April	21/2808	0.75%
May	24/3445	0.67%
June	22/2691	0.82%

Errors counted, and percentage calculated from total number of data elements for that month.

Table 3

Surgical Cancelations Percentage



Month	**#Cancellations**	**Percent**
January	7/207	3.38
February	9/203	4.43
March	9/252	3.57
April	9/216	4.17
May	6/264	2.72
June	8/207	3.86

Percent of cancellations calculated by dividing total cancellations for the month by total number of surgical cases.

Table 4

Surgical Start Variance

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
jTIME DIFFERENCE IN	175	438	-302	136	4.22	46.675	2178.553
fTIME DIFFERENCE IN	202	722	-398	324	25.85	70.718	5001.106
mTIME DIFFERENCE IN	250	384	-152	232	-.47	48.257	2328.708
aTIME DIFFERENCE IN	206	657	-192	465	1.35	78.724	6197.399
mayTIME DIFFERENCE IN	262	693	-157	536	13.11	56.483	3190.362
junTIME DIFFERENCE IN	207	254	-124	130	5.14	43.262	1871.558
Valid N (listwise)	166						

IBM SPSS 24 was utilized to generate descriptive data. Range was utilized because it was more dramatic to show. Number represent minutes of variation between scheduled and actual times.

Table 5

Surgical End Variance

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
jTIME DIFFERENCE OUT	175	371	-211	160	-24.90	54.578	2978.759
fTIME DIFFERENCE OUT	202	798	-489	309	.80	88.570	7844.727
mTIME DIFFEENCE OUT	249	368	-201	167	-32.41	56.951	3243.372
aTIME DIFFERENCE OUT	206	448	-197	251	-19.10	68.006	4624.830
mayTime DIFFERENCE OUT	262	618	-262	356	-15.62	73.981	5473.148
junTIME DIFFERENCE OUT	207	405	-157	248	-17.54	56.099	3147.065
Valid N (listwise)	166						

IBM SPSS 24 was utilized to generate descriptive data. Range was utilized because it was more dramatic to show. Number represent minutes of variation between scheduled and actual times.

Table 6

On-Time Starts

Statistics

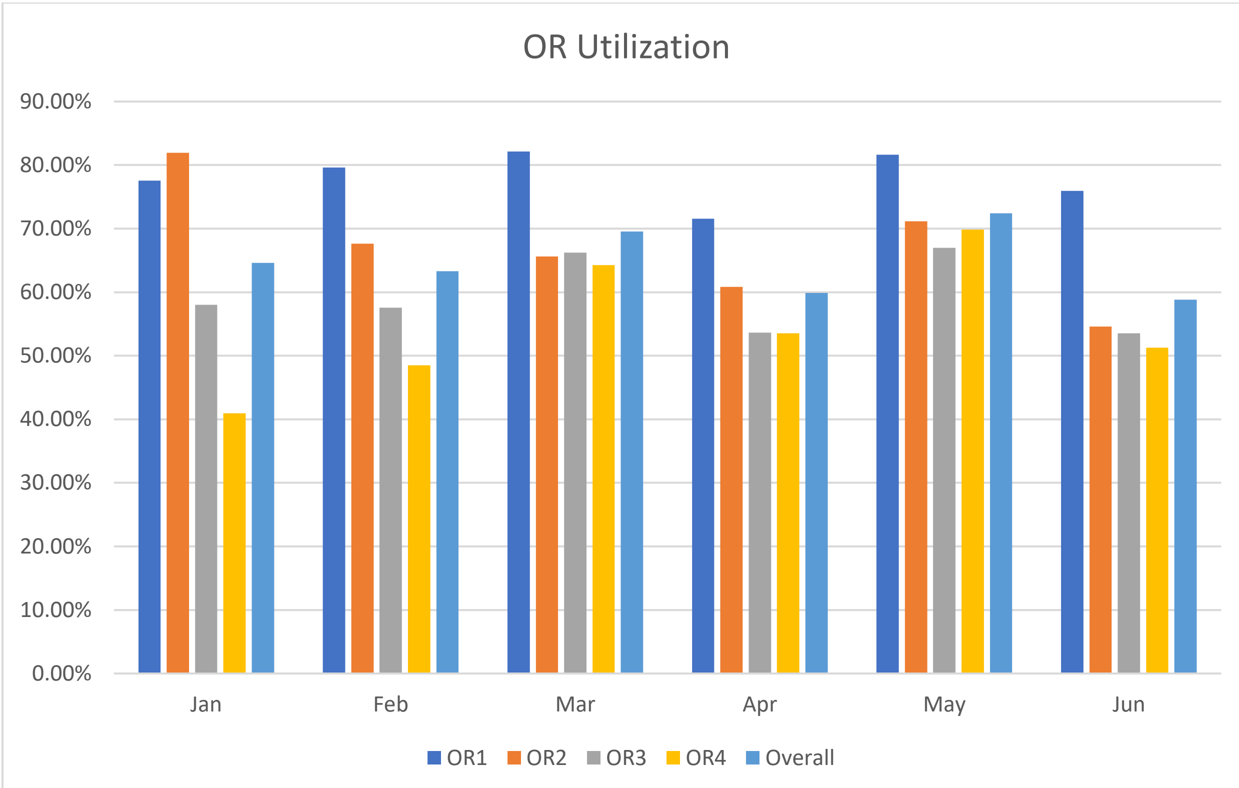
		jON-TIME START	fON-TIME START	mON-TIME START	aON-TIME START	mayON-TIME START	junON-TIME START
N	Valid	220	203	250	206	262	207
	Missing	42	59	12	56	0	55
Sum		19	16	15	9	24	22

Month	**#On-Time Starts**	**Percent**
January	19/220	8.34%
February	16/203	7.88%
March	15/250	6.00%
April	9/206	4.37%
May	24/262	9.16%
June	22/207	10.63%

IBM SPSS 24 was utilized to generate descriptive data. All on-time starts were totaled. They were then divided against the number of scheduled cases. Add-ons were not counted. Missing data represents add-ons to the surgical schedule that were not scheduled.

Table 7

Or Utilization

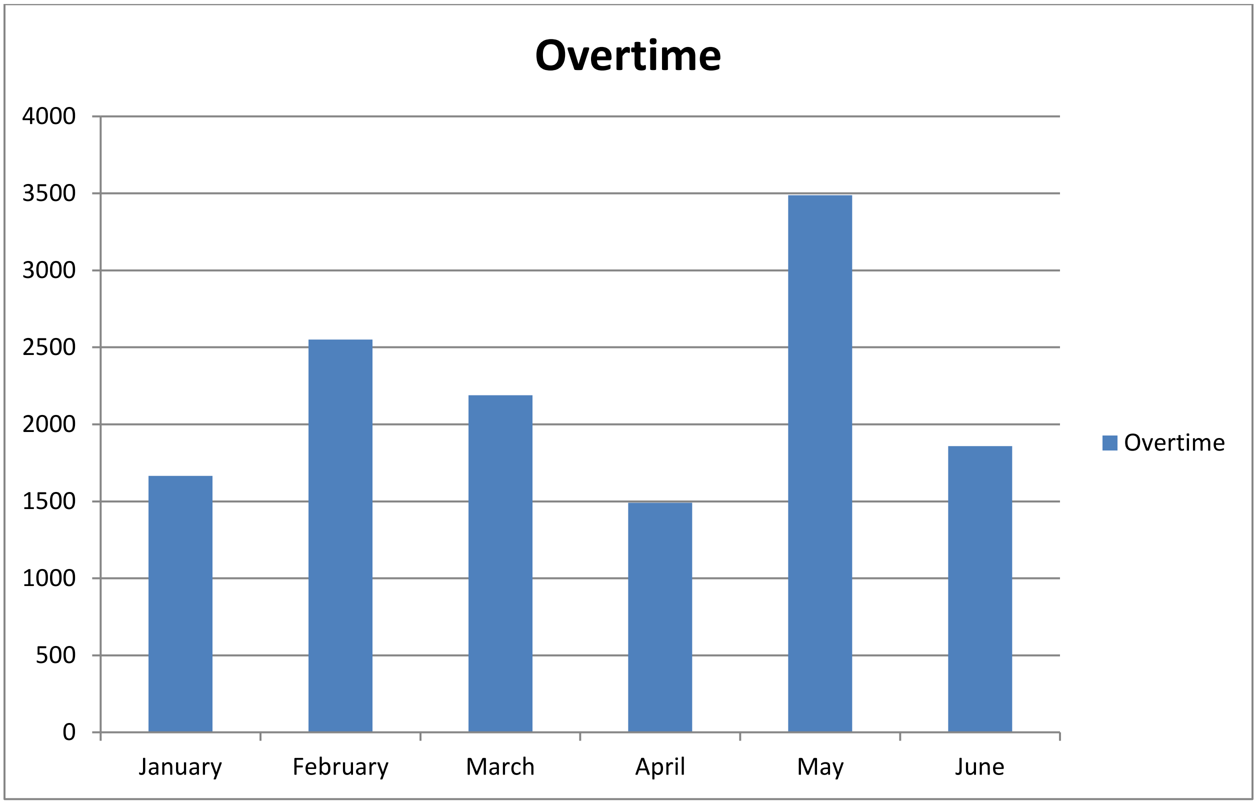


Month	OR1	OR2	OR3	OR4	Overall
January	77.53	81.92	58.00	40.95	64.60
February	79.62%	67.61%	57.54%	48.49%	63.32%
March	82.12%	65.64%	66.24%	64.27%	69.57%
April	71.55%	60.83%	53.65%	53.54%	59.89%
May	81.65%	71.16%	66.99%	69.86%	72.42%
June	75.96%	54.58%	53.53%	51.26%	58.83%

Percentage was calculated by total minutes OR was utilized in 8 hours minus cleaning time divided by 480 minutes, which equals 8 hours, times 100. Each day's percentage was calculated then totaled and divided by the number of scheduled OR days per month.

Table 8

Overtime



Month	**Total minutes OT**
January	1666
February	2551
March	2189
April	1490
May	3488
June	1859

Appendix A

DNP Statement of Non-Research Determination Form

APPLICATION FOR CLASSIFYING A PROJECT AS AN OPERATIONS ACTIVTY

Project Title: An Informatics Solution for Operating Room Efficiency: Data Collection and Analysis

Applicant Name: Richard Barrow RN-BC, MS, CCRN-CMC

1. Utilize the attached flow chart entitled "VHA Operations Activities That May Constitute Research." If you apply each of the steps, and get to "This Operations Activity is NOT RESEARCH" then go to Step 2 on this document.

2. What type of operational issue is this project addressing? Circle the letter preceding any of the categories that apply to your project (these are explained in greater detail in VHA Handbook 1058.05, Para 5b (1) – (6):

   a. Quality Assessment
   b. Quality Improvement --- XXXX
   c. Systems Redesign activity
   d. Competence or qualification reviews
   e. Medical review, medication use evaluations, legal analysis etc
   f. Business planning and development
   g. Underwriting and other activities related to the creation, renewal, or replacement of a contract of health insurance or health benefits and ceding, securing, or placing a contract for reinsurance of risk relating to health care claims
   h. Educational activity
   i. Assessment of an educational activity
   j. Other (describe):

3. How was the need to assess or address this operational issue identified, and why is this assessment/evaluation important to the organization?
   The need was originally identified through VASQIP data. It was subsequently discussed in several meetings and at the VISN level.

4. How does this project allow for assessment of this problem?
   It matches scheduled times against actual times such as OR start/end, Anesthesia start/end and so on.

5. How will the results of this project be used?
   The data will be used in several fashions. First is to identify to the VASQIP Coordinator missing OR times. Second is to identify problem areas such as certain types of surgery take longer, or significantly shorter, than allotted time.

The data can even by used to identify surgeons or surgical services that frequently do not meet their times.
None of this data is for punitive action. Rather it is for discovering opportunities for improvement

6. Who will be responsible for reviewing the findings of this activity, and/or undertaking any system changes?
   Richard Barrow will be responsible for developing, changing, and running the analytics until it can be automated.
   The data will be reviewed by the Surgical Nurse Manager, VASQIP Coordinator and Chief of Surgery if he desires.

7. Who will be responsible for evaluating the risks associated with this project (See VHA Handbook 1058.05, Paragraph 6b "Risks and Prevention" for a consideration of such risks) and responsible for ensuring appropriate protections to mitigate risks?
   Richard Barrow

8. Are you undertaking this project for the fulfillment of an educational requirement? Yes -XXX No.

   If yes, please explain: This is a significant portion of my DNP project

9. What is the expectation of your academic program with regard to this project, i.e. is the requirement to conduct a ***research*** project?
   Strictly prohibited from conducting research in the DNP program.

10. If "Yes" to #8 above, has the project been submitted to the IRB of your academic institution, or is there an expectation that it will be submitted to the IRB of your academic institution?
    Need a yes from you before I can submit the package to the University of San Francisco IRB.

11. How many hours per week will you devote to this project?
    I am devoting 1-2 hours per day outside of work (even though it is part of my job) to work on this project.

12. Apart from your time, are there other resources required for this project, e.g. training costs, educational materials etc.
    When I have the Fileman query almost built I will need a MUMPS programmer to assist me with the final formulas for the query. I can do most but I am still not skilled enough to do MUMPS programming.

13. Do you need assistance or support from others in this facility to conduct this project? (This does not refer to required approvals below, but others whose assistance you need, e.g. someone to pull CPRS data, someone to obtain DSS data for you)

Yes No - XXXX

If yes, please indicate whose assistance you need, and for what purpose:

14. A written plan for the scope and conduct of the activity must accompany this application (i.e. a project description)

Richard A. Barrow

Signature: Richard A. Barrow RN-BC, MS, CCRN-CMC

Date: 5/17/16

SUPERVISOR ENDORSEMENT:

___X___I have reviewed this project and I support the project itself, the use of staff time that this project entails and support the use of other resources required for this project.

_______I do not support this use of VA resources

Signature: Michael Provenche

Date 5/18/16

SERVICE CHIEF ENDORSEMENT (IF SERVICE CHIEF IS NOT IMMEDIATE SUPERVISOR)

_______I have reviewed this project and I support the project itself the use of staff time that this project entails and support the use of other resources required for this project.

_______I do not support this use of VA resources

Signature:

Date:

NURSE EXECUTIVE ENDORSEMENT (required for all projects initiated by nursing staff):

___✓___I have reviewed this project and I support the project itself, the use of staff time that this project entails and support the use of other resources required for this project

_______I do not support this use of VA resources

Signature: Charles V. Sitterer

Date: 5/20/16

CHIEF OF STAFF ENDORSEMENT (required for all projects involving clinical staff or projects involving clinical services or practice)

___X___I have reviewed this project and I support the project itself, the use of staff time that this project entails and support the use of other resources required for this project

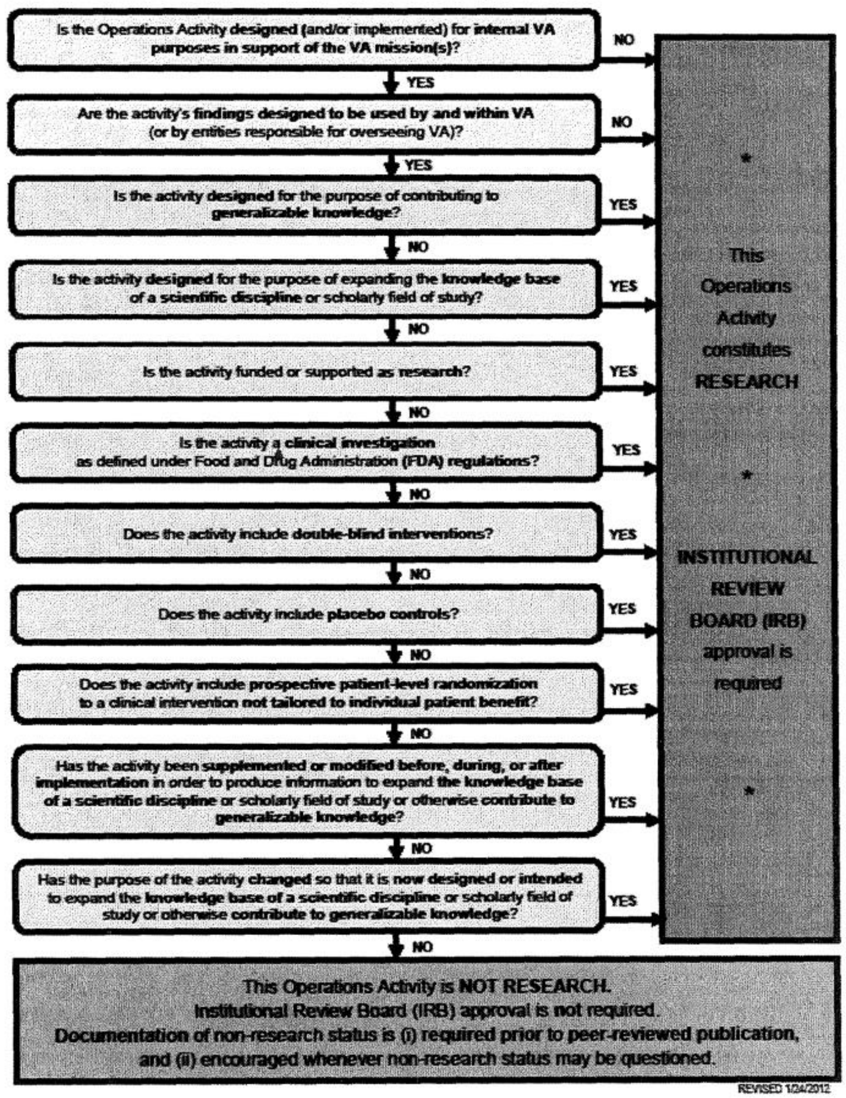
_______I do not support this use of VA resources

Signature:

Date: 5/23/16

Version July 16, 2012

VHA Operations Activities That May Constitute Research



Executive Summary

An informatics solution for Operating Room (OR) efficiency is about creating an analytic program to supplement the Veteran's Administration Surgical Quality Improvement Program (VASQIP). The analytics will identify missing data from the patient's record regarding the patient's surgery. The analytics will also provide the Surgical Nurse Manager with data to improve operating room efficiency.

VACCHCS has only one full time employee who dedicates half of her time to VASQIP. Mull, Borzecki, Hickson, Itani, and Rosen (2013) state that VASQIP is labor intensive due to the manual methods of data extraction. The data from the analytics will make her time more efficient through being able to detect records that are incomplete from the operating room encounter. This will be facilitated by markers on the report to draw the reader's attention to missing data. This will allow the VASQIP Coordinator to select those missing data rather than reviewing every chart for missing data.

The analytic solution is based upon what elements constituted OR efficiency. So the elements are broken down into patient demographics, type of surgery, surgical service, surgeon, operating room times, surgical times, anesthesia times, and cleaning times. The times are documented as scheduled and actual. This will allow comparison of the times and provide the OR Manager with useful data to better direct the schedulers and provide feedback to the various surgical services.

This solution is needed now to provide veterans with a more efficient OR thereby decreasing wait times for elective surgeries. This solution is also needed to decrease costs

Appendix B

Evaluation Tables

Evidence Table

Reference	Design Method	Focus	Findings	Appraisal: Worth to Practice
Rempfer, D. (2015). Using perioperative analytics to optimize OR performance. *Health Financial Management*, *69*(6), 82-85.	Case Studies	Employing analytics to improve operating room efficiency	Analytics if employed correctly increase operating room efficiency, cost capture, and reimbursement	Weakness 1. Expert opinion 2. No citing of failures Strength 1. Case studies cited were in large urban areas 2. Citing analytics able to effect change 3. Citing high buy-in from entire facility **
Phieffer, L., Hefner, J. L., Rahmanian, A., Swartz, J., Ellison, C. E., Harter, R., . . . Moffatt-Bruce, S. D. (2016). Improving operating room efficiency: first case on-time start project. *Journal of Healthcare Quality*, *0*(0), 1-9. doi:10.1097/JHQ.0000000000000018	Case Studies	Employed an interdisciplinary Operating Room Committee to apply Six Sigma tools to this problem. The steps of this project included (1) problem mapping, (2) process improvements to preoperative readiness, (3) informatics support improvements, and (4) continuous measurement and feedback.	There was a peak of 92% first case on-time starts across service lines, decreasing to 78% through 2014, still significantly above the preintervention level of 49% (p = .000). Delay minutes also significantly decreased through the study period (p = .000). Across 2013, the most common delay owners were the patient, the surgeon, the facility, and the anesthesia department.	Weakness 1. A single facility 2. Authors showed over time decrease in effectiveness Strength 1. Authors cited “Culture of inefficiency” 2. Authors forthright in findings even if negative 3. 26 operating room facilities **

**** denotes appropriate John Hopkins Rating Tool score is in Review of Evidence section**

Reference	Design Method	Focus	Findings	Appraisal: Worth to Practice
Tanaka, M., Lee, J., Ikai, H., & Imanaka, Y. (2013). Development of efficiency indicators of operating room management for multi-institutional comparisons. *Journal of Evaluation in Clinical Practice, 19*(2), 335-341. doi:10.1111/j.1365-2753.2012.01829.x	Randomized Control Trial	Creating indicators to equalize facilities in analytics about equalizing size and staffing through specialized indicators	Using the ratio of observed to expected values (OE ratio), as well as the difference between the two values (OE difference) allows hospitals to identify weaknesses in efficiency with more validity when compared to unadjusted indicators. The new indicators may support the improvement and sustainment of a high-quality health care system.	Weakness 1. Research has not been replicated successfully 2. A manual process which could be error prone Strength 1. Conducted in 224 hospitals which gave each facility equal footing when being compared 2. Surgical and anesthesia times were approximated **
Hovlid, E., & Bukve, O. (2014). A qualitative study of contextual factors' impact on measures to reduce surgery cancellations. *BMC Health Services Research, 14*, 215. doi:10.1186/1472-6963-14-215	Qualitative Study	A qualitative case study at a hospital, where it had been previously demonstrated a reduction in surgery cancellations. 20 clinicians were interviewed, and the authors performed a content analysis to explore how contextual factors affected measures to reduce cancellations of planned surgeries.	Three common themes concerning how contextual factors influenced the change process: 1) identifying a need to change, 2) facilitating system-wide improvement, and 3) leader involvement and support.	Weakness 1. A single facility 2. Study not replicated Strength 1.Brings in the human element into numbers 2. Utilizes an established framework MUSIQ **

**** denotes appropriate John Hopkins Rating Tool score is in Review of Evidence section**

Reference	Design Method	Focus	Findings	Appraisal: Worth to Practice
Wang, N., Hailey, D., & Yu, P. (2011). Quality of nursing documentation and approaches to its evaluation: a mixed-method systematic review. *Journal of Advanced Nursing*, *67*(9), 1858-1875. doi:10.1111/j.1365-2648.2011.05634.x	Mixed-Method Systematic Review	A review that identified and synthesized nursing documentation audit studies, with a focus on exploring audit approaches, identifying audit instruments and describing the quality status of nursing documentation	Seventy-seven publications were included. Audit approaches focused on three natural dimensions of nursing documentation: structure or format, process and content. Numerous audit instruments were identified, and their psychometric properties were described. Flaws of nursing documentation were identified and the effects of study interventions on its quality.	Weakness 1. Not specific to operating room efficiency 2. Inconsistencies in definition of good nursing documentation Strength 1. Comprehensive systematic review **

**** denotes appropriate John Hopkins Rating Tool score is in Review of Evidence section**

Synthesis Table

PICOT Question: In surgical services, how does an analytic program of Veteran's Administration Surgical Quality Improvement Program (VASQIP) data, that can be run daily, compare to the current practice of reviewing data every 90 days affect operating room efficiency within a 120-day trial period?

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings
Level 1 • Experimental Study • Randomized Control Trial (RCT) • Systematic review of RCTs with or without meta-analysis	1	A	VASQIP is a set of analytics that does not consider staffing, other than OT, and facility size. This study demonstrates an elegant method of equalizing the facilities to give a more accurate method of operating room efficiency
Level II • Quasi-experimental studies • Systematic review of a combination RCTs and quasi-experimental studies or quasi-experimental studies only, with or without meta-analysis	0	N/A	N/A

Category (Level Type)	Total Number of Sources/Level	Overall Quality Rating	Synthesis of Findings
Level III • Non-experimental studies • Systematic review of a RCTs, quasi-experimental, and non-experimental studies only, with or without meta-analysis • Qualitative study or systematic review of qualitative studies with or without meta-synthesis	3	A	The article which discussed case studies shows that analytics can improve operating room efficiency. The qualitative study coupled with Transitions Theory and Complexity Theory bring in the human element of analytics and enhance the conceptual framework. The mixed-method systematic review also enhances the conceptual framework. Analytics is more than numbers it represents people interacting with one another for a common goal.
Level IV • Opinion of respected authorities and/or reports of nationally recognized expert • Committees/consensus panels based on scientific evidence	1	B	This article highlights several case studies which demonstrated how analytics can improve operating efficiency and patient safety.
Level V • Evidence obtained from literature reviews, quality improvement, program evaluation, financial evaluation, or case reports • Opinion of nationally recognized expert(s) based on experimental evidence	0	N/A	N/A

Appendix C

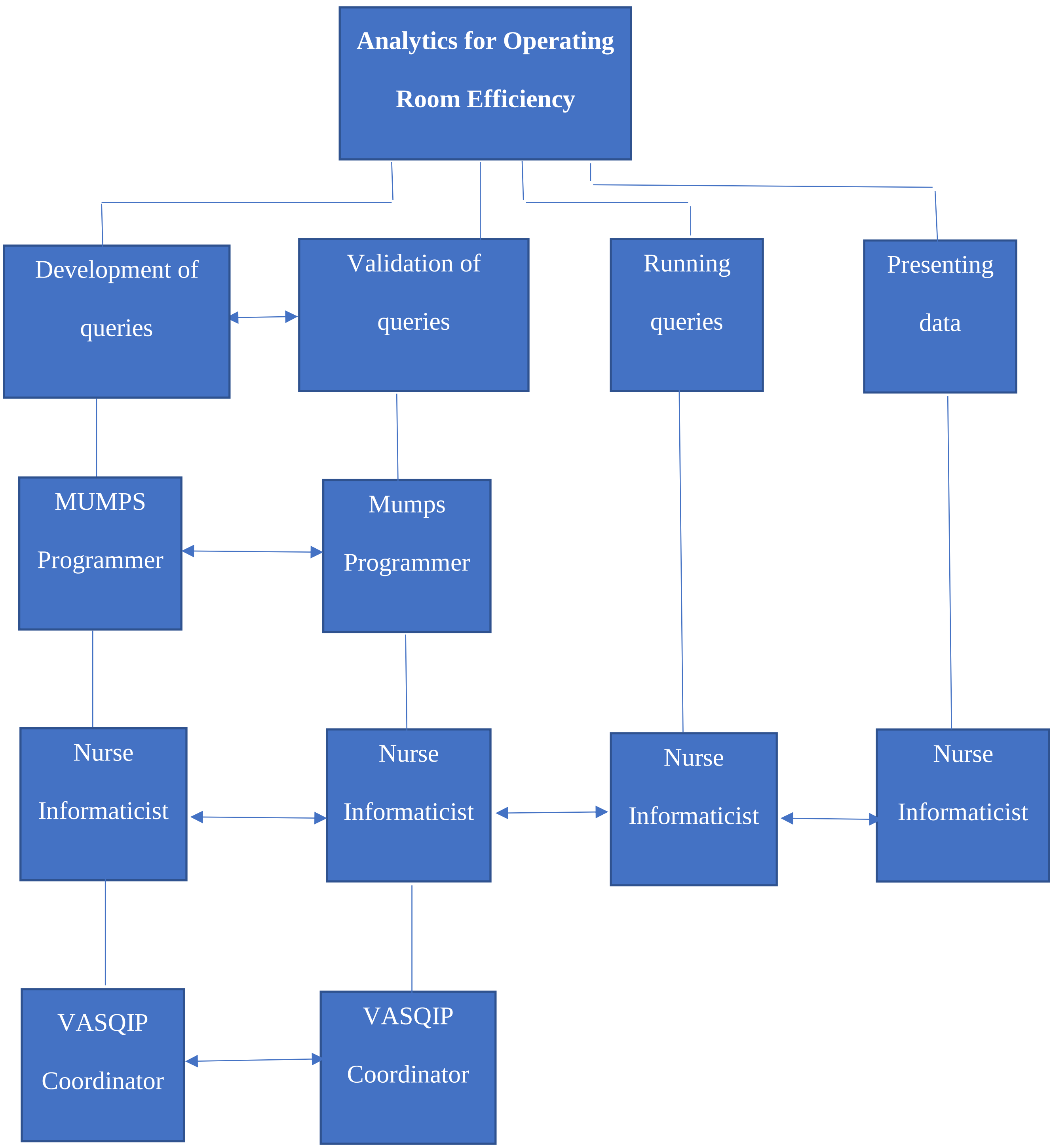
Project Gant Chart

	Jul 16	Aug 16	Sep 16	Oct 16	Nov 16	Dec 16	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Evaluation
Research	XXX												100%
Obtain access to database	XXX												100%
Identify data element table		XXX											100%
Write query		XXX	XXX										100%
Test and validate analytics				XXX	XXX	XXX							100%
Roll out of analytics							XXX	XXX	XXX	XXX	XXX	XXX	100%

Appendix D

Work Breakdown Structure

Project Name	Analytics for Operating Room Efficiency	**Facility Name**	A Central California Hospital
Project Manager	Richard Barrow	**Date Range**	July 2016 – June 2017



Appendix E

Communication Matrix

Information	Receiver	Timing of Communication	Method of Communication	Sender
Data elements	Nurse Informaticist, MUMPS programmer, VASQIP Coordinator	Daily then progressed to as needed	email, phone call	Nurse Informaticist, MUMPS programmer, VASQIP Coordinator
Query development	Nurse Informaticist, MUMPS programmer	Daily then progressed to as needed	email, phone call	Nurse Informaticist, MUMPS Programmer, VASQIP Coordinator
Project Progress	Nurse Executive, Program Chair, Surgical Nurse Manager, Chief of Surgery	Monthly	email, phone call	Nurse Informaticist
Request for review and data validation	Nurse Informaticist, MUMPS programmer, VASQIP Coordinator, Surgical Manager	Weekly then progressed to monthly	email, phone call	Nurse Informaticist, MUMPS programmer, VASQIP Coordinator, Surgical Manager
Analytics	Nurse Executive, Associate Nurse Executive, Surgical Manager, VASQIP Coordinator	Monthly	email	Nurse Informaticist

Appendix F

SWOT

<table>
<tr><td>Strengths
• Ability to identify problem areas
• Ability to identify individual surgical services
• Ability to identify individual practitioners
• Ability to identify case types that might need to be re-evaluated for times and time slots</td><td>Weaknesses
• Analytics needs to be manually run in the beginning
• Dependent upon human entry of data accurately
• Dependent upon outsider building and maintaining analytic program
• Multiple OR schedulers</td></tr>
<tr><td>Opportunities
• Identify problem areas and improve them
• Decrease surgical backlog through increase efficiency
• Decrease adverse events through increase efficiency
• Increase revenue through OR efficiency
• Increase staff satisfaction through OR efficiency
• Increase patient satisfaction through OR efficiency</td><td>Threats
• Change in VistA Surgical Package
• Updates to Clinical Data Warehouse
• Staff turnover
• Loss of experienced OR schedulers
• Falsifying the OR times so they don’t look bad
• The analytic tool being turned into a punishment tool rather than a performance improvement tool as designed</td></tr>
</table>

Appendix G

Project Cost

Analytic	Project	FY16	
People	Hours allocated	Rate	Cost
Informatics RN Development	440	$57.00	$25,080.00
MUMPS Programmer Development	80	$55.00	$4400.00
VASQIP Coordinator	80	$65.00	$5200.00
Informatics RN Project	240	$57.00	$13,680.00
Total			$48,360.00

Appendix H

System Development Life Cycle

Conceptualization/ Planning	Analysis & Definition	Design & Redefining	Develop	Testing	Implementation	Operation & Evaluation
See the problem and discover possible solutions. What are the costs of problem not resolved and is there an opportunity to improve patient care as well as reduce cost.	Define the problem and needs of the client Define the goal. Re-evaluate projected costs and benefits	Parameters are defined. Possible solution is put in writing for evaluation where parameters are well defined as well as goals	Prototype is created from scratch	Prototype is tested and refined and/or remade and retested	Final product is placed into limited production for final evaluation and data validity. End users are shown preliminary data for refinement of queries if needed.	Final product is running, and data is sent to end users for use and evaluation if any additional requirements or questions arise
Evaluate	Evaluate	Evaluate	Evaluate	Evaluate	Evaluate	Evaluate

Appendix I

Glossary of Terms

Analytics: the use of logical analysis to determine discrete elements with regard to operating room efficiency (Dictionary.com, 2016).

Efficiency: effective operation as measured by a comparison of production with cost (as in energy, time, and money) (Merriam-Webster, 2016)

Massachusetts General Hospital Utility Multi-Programming System (MUMPS): a general-purpose computer language that VISTA utilizes.

Operating Room efficiency: defined by quantitative measures of: 1) missing or erroneous data in the surgical chart, 2) cancellations of surgical cases on day of surgery, 3) variances in time of scheduled versus actual surgical start times and ends, 4) on-time starts, 5) operating room utilization based on actual use out of an eight-hour day, 6) overtime which is any time worked after end of scheduled shift or before schedule shift start.

Veterans Administration Surgical Quality Improvement Program (VASQIP): A Veteran's Administration (VA) mandated program that collects data on (1) Surgical mortality and morbidity outcomes from VASQIP; (2) Critical surgical safety events; (3) Volume of surgical cases by specialty; (4) Procedural volume by surgical complexity category; (5) Compliance with surgical complexity program designation; and (6) Indicators of access, efficiency, productivity, and utilization. (VHA Handbook 1102.1, 2013)

Veteran's Information System Technology Architecture (VISTA): a nationwide information system and Electronic Health Record (EHR) developed by the U.S. Department of Veterans Affairs (VA)